

The provision of adult intensive care in Northern Ireland with reference to the role of high dependency care

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Summary

In 1991 an audit of Intensive Care Services was carried out by the Northern Ireland Intensive Care Group. In conjunction with this regional overview, all patients in the Regional Intensive Care Unit, (RICU) in the Royal Victoria Hospital were assessed daily, over a 10 month period in 1990-91 and classified as conforming to either intensive care or high dependency status. These data were then used to compare adult intensive care service in Northern Ireland with recent national and international recommendations on intensive care.

Ten units in Northern Ireland were surveyed. In regard to national or international guidelines, all ten were deficient to some degree. Four units had significant deficiencies; small patient numbers, lack of 'dedicated' 24hr medical cover and or deficiencies in the provision of appropriate monitoring and or equipment. There was a large diversity in casemix among the ten units surveyed which suggested differing admission criteria.

The bed occupancy of RICU was 100%. Refused admissions constituted a further 13% of unresourced workload. The lack of physically separate, dedicated high dependency unit facilities meant that 26% of bed days were devoted to HDU care (usually for "improved" intensive care unit patients not yet ready for discharge to a general ward).

Achieving nationally recommended intensive care standards (on a regional basis) is probably only possible if a number of the smaller intensive care units are redesignated as high dependency units, and patients requiring intensive care are concentrated in a smaller number of larger ICUs. This will increase the frequency of interhospital transfer of critically ill patients.

INTRODUCTION

During the last decade there has been a significant increase in the numbers of patients admitted to the Intensive Care Unit (ICU). Unfortunately, there has not been an equivalent increase in ICU beds. Coupled with this, technical advances, willingness by surgeons to perform radical surgery in an increasingly elderly population, and public expectation have all served to further increase ICU workload. However, as well as pressing for extra resources it is also important that those already available are used appropriately and efficiently.¹⁻² Recommendations on ICU provision and operational policy have been drawn up both by national bodies such as the Royal College of Anaesthetists³, the Association of Anaesthetists⁴

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and the Intensive Care Society (UK)^{5,6} and also by international bodies, the European Society of Intensive Care Medicine^{7,8} and the Society of Critical Care Medicine.⁹ The Clinical Resource Efficiency Team (CREST)¹⁰ has reviewed intensive care in Northern Ireland and made recommendations which have stimulated change within individual units but as yet have had little influence on the regional strategy for Intensive Care across the province.

This paper has been constructed in two sections;

- (A) An audit of ICU provision and activity in Northern Ireland conducted in association with the Northern Ireland Intensive Care Group (NIICG).
- (B) An analysis of the workload and case-mix in the largest ICU within Northern Ireland.

Since ICU care and high dependency unit (HDU) care may go on side by side within an ICU, and an HDU patient should need less clinical and financial resources than an ICU patient, it is necessary to define the respective patient populations.

DEFINITIONS:

Intensive Care Patient: An intensive care patient is one admitted for the treatment of impending or actual organ dysfunction which is potentially reversible.^{5,10,11} An intensive care patient may also be defined as one for whom the facilities of an HDU are insufficient.^{3,4} We defined an ICU patient in terms of features which reflect various aspects of organ dysfunction (Table I).

High Dependency Patient: A HDU patient requires a level of care intermediate between that delivered in ICU and the best which could be provided on a standard ward.^{5,10} In this study we defined a HDU patient as one who did not conform any of the features in Table I but who occupied an ICU bed.

SECTION A.

Ten ICUs, designated by the code letters A-J (Table II) were surveyed by means of a postal questionnaire on aspects of clinical activity, staffing and equipment levels. The questionnaires were completed by a consultant in all cases, and telephone follow-up was used to elicit returns from non-responders, and to clarify ambiguous or incomplete responses. We compared the information received with previously published recommendations³⁻⁵ (Table III).

RESULTS

Number of admissions

Three units (F, I and J) had fewer than 200 admissions per year (the minimum recommended) and in the other units admission rates ranged from 215 to 559 patients per year (Table II). In units I and J, mechanical ventilation was instituted in less than 5% of patients, three other units (F, G and H) ventilated less than 30% of admissions and only three units (A, B and C) instituted mechanical ventilation in more than 50% of patients requiring mechanical ventilation (figure 1). This (and other less specific information) revealed that the admission criteria varied considerably from unit to unit.

Number of beds

One unit (J) had less than 4 beds (minimum recommended) and all other units had some beds which were closed due to lack of funding for nursing staff.

Consultant sessions

Only unit A had enough sessional allocation to have 24-hour dedicated consultant cover. Unit C had 10 consultant sessions allocated – allowing daytime cover during the standard working week. Emergency cover in this unit was by the consultant on call for anaesthesia who usually did not have daytime ICU sessions. The remaining units had between two and eight week-day consultant sessions with the remainder of 24 hour cover being provided by consultants who were also on-call for other areas e.g. day time theatre duties, obstetric cover or anaesthesia on-call.

Administration

All units had a named consultant in administrative charge.

Junior medical staff

Units A and C had dedicated 24-hour resident cover by non-consultant medical staff. In both cases these were anaesthetists-in-training. Two units (I & J) had no resident cover i.e. there were no trainee anaesthetists resident in the hospital. The non-consultant staffing of the other units was variable with anaesthetic trainees providing an ICU commitment which was combined with commitments elsewhere in the hospital.

Illness severity scoring and Audit

Only three units (30%) frequently used illness severity scoring. All three used the Acute

TABLE I

Criteria for ICU classification (any one of the following)

Patients requiring positive pressure ventilation
Intubated patients requiring use of continuous positive pressure breathing circuit (CPAP)
Patients requiring management using a pulmonary artery flotation catheter
Patients requiring intra-cranial pressure monitoring
Patients in acute renal failure requiring haemodialysis with at least one other organ system failure
Patients exhibiting cardio-respiratory instability requiring ongoing resuscitation

TABLE II

Key points describing ICUs in Northern Ireland compared with international guidelines

ICU	Beds	Admissions Total	%HDU	Dedicated Consultant (24 hr/full daytime/ other)	24 hr Junior Medical cover	Illness scoring
A	8	559	16%	24 Hrs	Y	Y
B	4	279	37%	Others	variable	N
C	6	387	29%	daytime	Y	Y
D	5	269	61%	Other	variable	N
E	4	228	53%	Other	variable	Y
F	4	67	58%	Other	variable	N
G	4	215	65%	Other	variable	N
H	4	265	58%	Other	variable	N
I	7	199	95%	Other	None	N
J	3	137	94%	Other	None	N
Guide -lines	>4	>200	<50%	24 hrs	Y	Y

Physiology and Chronic Health Evaluation (APACHE II) system.¹² There was no information on clinical audit requested in the questionnaire.

Equipment and Facilities

Table III summarises the criteria drawn up by the European Society of Intensive Care Medicine⁸ for ICU bed-side equipment and unit facilities. These would suggest that there are deficiencies in the provision of almost every category of equipment in every ICU in the province. Overall the larger ICUs were better equipped with the

exception of the provision of pulse oximetry devices which was at best one device per two beds in the two busiest ICUs. The authors felt that a minimum of three infusion control devices (volumetric pump/syringe driver) per bed should be available – four units (A, F, I and J) did not fulfil this requirement.

SECTION B

Introduction

The Regional Intensive Care Unit, Royal Victoria Hospital (RICU) is an 11 bedded unit possessing

TABLE III

Equipment levels in ICUs in Northern Ireland (ESICM guidelines require all answers to be Y and ratio of no/total beds to be 1/1).

<i>Equipment</i>	<i>Intensive Care Units</i>									
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>
Pulse Oximeter no/total beds	4/8	2/4	2/6	1/5	2/4	1/4	2/4	1/4	7/7	2/3
ECG	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Intra-arterial pressure monitoring	Y	Y	Y	Y	Y	N	Y	Y	N	N
Mechanicalventilator no/total beds	Y	Y	Y	Y	Y	N	Y	Y	N	N
Non-invasive blood pressure	N	N	N	N	N	N	N	N	Y	N
Bedside blood gas measurement	Y	Y	Y	Y	Y	Y	N	N	N	Y
24 hr Technical support	Y	Y	Y	N	Y	Y	N	N	N	N
>3 infusion devices per bed	N	Y	Y	Y	Y	N	Y	Y	N	N

TABLE IV

Mean APACHE II and TISS scores by month over a 4 month period.

		<i>APACHE II</i>		<i>TISS</i>	
Month 1	category	- ICU	14		39
		- HDU	8		17
Month 2	category	- ICU	13		40
		- HDU	7		24
Month 3	category	- ICU	15		36
		- HDU	12		23
Month 4	category	- ICU	15		34
		- HDU	12		24
Mean (SD) [Range]		- ICU	14.3 (0.96)		37.3 (2.75)
			[13-15]		[34-40]
		- HDU	9.75 (2.63)		22 (3.37)
			[8-12]		[17-24]

(at the time of this study) staff and funding for eight beds. It provides general intensive care services for adult patients in the Royal Group of Hospitals and for other hospitals which do not have an ICU. It also provides a province-wide service in conjunction with numerous regional specialties which are located within the hospital. In addition, when beds are available it accepts patients from other ICUs when such a transfer is felt appropriate by the referring staff. RICU has no associated high dependency unit (HDU) and so patients requiring HDU care receive this either in ICU or go to a standard ward where the ability to deliver a level of care approaching that of an HDU is variable.

The workload of RICU was investigated over a ten month period.¹³ Each day the ICU consultant and registrar designated each patient in the unit as either an ICU case or an HDU case, using the criteria in Table I thereby constituting an ICU or HDU 'patient-day'. The data were also used to calculate bed occupancy in the unit based on the eight staffed beds. Patients who were refused admission to RICU due to lack of nursing staff or beds were documented. For four consecutive months within the 10 month study, every patient had daily APACHE II (Acute Physiological and Chronic Health Evaluation) and Therapeutic Intervention Scoring System (TISS) scores calculated.¹⁴ With both scoring systems higher scores suggest more severe illness.

Results

During the study period, with 8 ICU beds functioning, there were 2432 patient days available. Three hundred and seventy-six patients utilised 2451 patient days – 101% of the days available. This occurred because patients were sometimes admitted to beds which were officially unstaffed. This was not unit policy but arose simply due to over-riding clinical indications for ICU care which could not be provided elsewhere. During the study there were 49 refusals to admit for reasons of lack of staff or beds. This represents an additional workload of 13% (assuming an average length of stay of 6.3 days) which could not be accommodated and is almost certainly an underestimate given the voluntary nature of the reporting and the fact that, when RICU was known to be full, further requests for admission may not have been made. Over a twelve month period in Belfast City Hospital ICU, there were 40 recorded refusals to admit.

During the study, 628 patient-days (26%) were devoted to HDU care. Four hundred and sixty-one (73%) of the HDU patient-days were required for patients formerly designated as ICU cases whose condition had improved but who were still not suitable for standard ward care.

With regard to ICU/HDU status, we found APACHE II scoring was not particularly helpful in differentiating ICU and HDU patients. There was a continuous spread of APACHE II scores although most ICU patients had scores >12 and most HDU patients had scores <12 (Table IV). TISS scores <24 were associated with HDU status and scores >34 with ICU status. This loose association is not surprising, since the criteria used to define ICU status were like TISS, based mainly on therapeutic interventions.

Discussion

This paper is the first to attempt to assess the adequacy of ICU provision in Northern Ireland against national and international standards. Although the information was collected four years ago, little has changed in the interim with respect to total number of ICU beds available or number of units delivering ICU/HDU care.

One of the difficulties facing all hospitals is the provision of a continuum of care, as dictated by the patient's condition, ranging from intensive care, through high dependency care, to general ward care and rehabilitation. In a United Kingdom survey only 23% of acute hospitals had both ICU and HDU facilities.⁴ In some units surveyed the HDU proportion of workload exceeds 50%.^{4,11} In order to maintain local ICU expertise it is recommended that at least 50% of the patients conform to ICU rather than HDU status.³ The data summarised in Table II would suggest that units A, B and C are correctly described as ICUs whereas units I and J appear to be functioning as HDUs. Units D, E, F, G and H have a dual ICU/HDU role although in many the HDU role is predominant.

High Dependency Units differ from intensive care units primarily in the lower nurse staffing ratio per patient and in the lower level of provision of monitoring and other equipment. The recommended nurse: patient ratio in an ICU is 1:^{14,10} compared with 1:2 for an HDU.¹⁰ In terms of nursing whole time equivalents (WTEs) an ICU bed requires 6-7 WTEs and an HDU bed approximately 3-5 WTEs for 24 hour cover 365

TABLE V

Consequences of using over-extended ICU facilities for HDU care

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- Postponement at short notice of major elective surgery
 - Inability to admit ICU patients from own or other hospitals
 - Management of ICU patients in non-regional ICUs/Recovery rooms
 - Inter-hospital transfer of regional ICU patients to non-regional ICUs
 - Pressure to discharge early/high re-admission rate
 - Inability to provide training/teaching
 - Inability to provide for emergency situations
 - Stress related problems for staff/high staff turnover rate
-

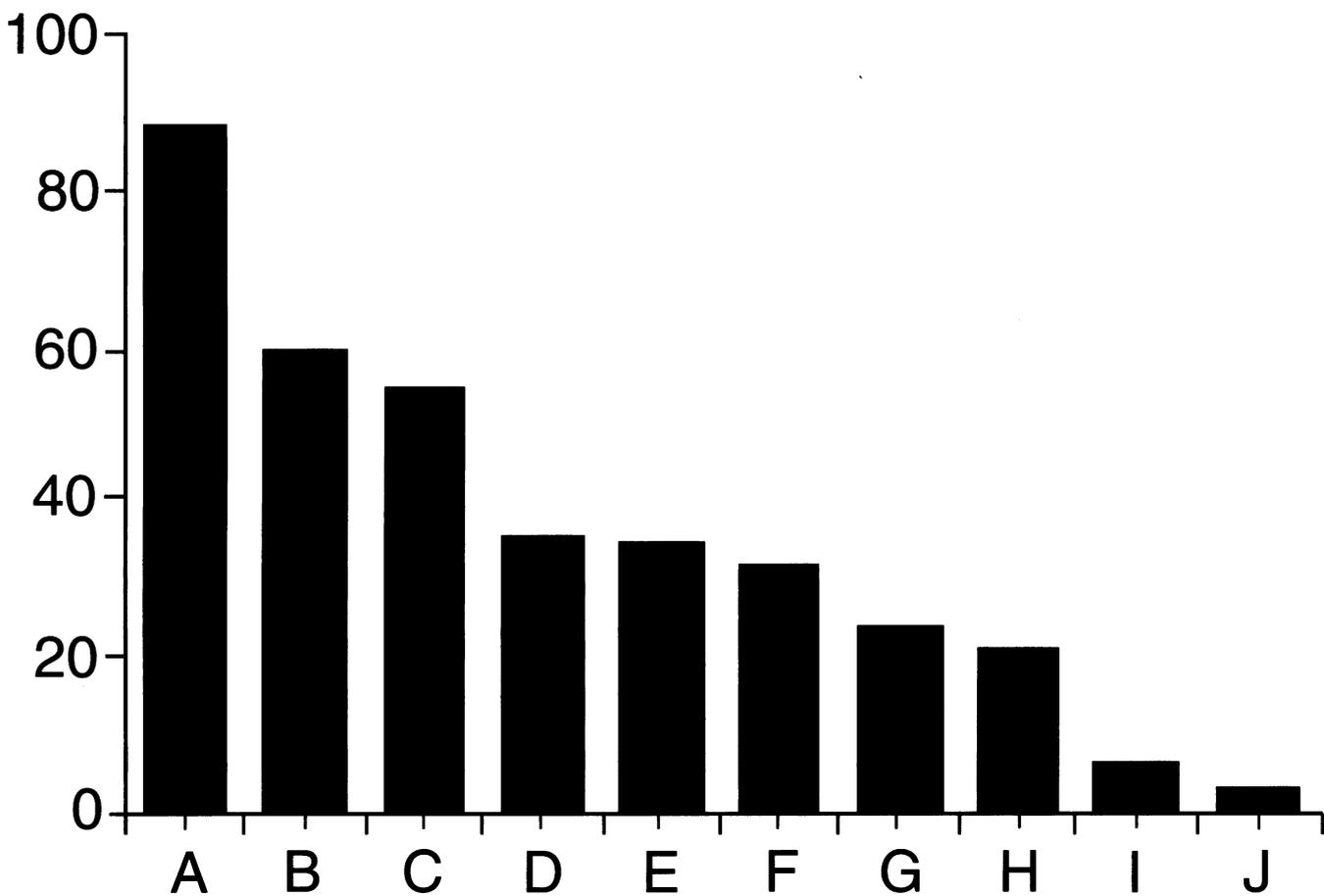


Figure Percentage of total admissions receiving mechanical ventilation by unit (designated A-J)

days per year. It is inefficient to look after high dependency patients in an ICU setting because the staffing and equipment advantages are lost. In addition, such a situation reduces the pool of ICU beds available for the treatment of the most seriously ill patients. Thus the absence of HDU facilities, due to a knock-on effect, reduces the capability to provide an ICU service at a time when it appears that there is a shortfall in ICU beds.

It is recommended that an ICU operates at 70% bed occupancy rate to allow for emergency admissions.^{4, 10} An overextended ICU may face some of the problems outlined in Table V and these may be offset by the availability of an HDU to cater for patients not conforming to intensive care status but who are not yet well enough for general ward care. As a significant component of HDU workload is derived from ex-ICU patients¹³ it is appropriate that a HDU should be situated adjacent to an ICU.⁵

It would appear from the above that some ICUs surveyed do not comply with the recommendations set out above³⁻¹⁰ or European Intensive Care Society recommendations regarding equipment⁸ (Table IV). Some have an insufficient number of admissions and others apply admission criteria which are based on local factors, but which would not normally be appropriate for intensive care. Technological advances in the investigation, treatment and monitoring of intensive care patients may place this type of advanced care beyond the range of some units. ICUs failing to meet previously mentioned guidelines provide insufficient clinical exposure and training opportunities for staff and are invariably inefficient.⁴

In order to address some of the problems outlined above, ICU care in Northern Ireland would need to be more centralised which may mean more frequent inter-hospital (IH) transfer. IH transfer may be associated with a deterioration in the patient's condition if the process is not properly conducted.^{15, 16} Therefore it is of vital importance that the patients are adequately resuscitated and stabilised before transfer, monitored appropriately and accompanied by sufficiently experienced personnel.¹⁷ This has staffing and equipment implications for both the referring and receiving hospitals. Clearly some small hospitals may be left without anaesthetic cover during transfer of critically ill patients¹⁸ or they may be tempted to

use inexperienced junior staff for this purpose. In some United Kingdom centres the receiving ICU retrieves the patient with a purpose-built and appropriately staffed mobile ICU thus overcoming the aforementioned staffing problems in the transferring hospital.¹⁷

It can be seen from the high number of refused ICU admissions that lack of available ICU beds appears to be a significant problem, at least in Belfast. The number of ICU beds, as a proportion of total acute beds, has been recommended as 1-2%^{3, 10, 19} although, elsewhere for example in Germany the proportion may be as high as 10% in a University teaching hospital with regional specialties.⁷ Greater emphasis on day surgery and shorter length of stay after operation will decrease the total number of acute hospital beds, and so ICU beds as a percentage of total hospital beds should actually be increasing. The number of ICU beds required within Northern Ireland is linked to (i) the provision for HDU care (ii) the appropriate use of ICU beds using accepted admission criteria and (iii) an accepted maximum bed occupancy for ICU which allows the capacity to respond to peaks in demand and provide scope for in-service training for staff. Thus it is impossible to give figures for ICU bed requirements in Northern Ireland. What is needed is an increase in the number of ICU beds, with proper audit to ensure that they are providing an ICU and not an HDU service. Where these extra beds should be provided is also difficult although it would appear prudent to provide the busiest units with more capacity and to provide more ICU capacity within Belfast which appears to have a significant mismatch between referrals and resources.

In conclusion, it would appear that, in Northern Ireland, of the 49 beds designated for "general adult intensive care" around 50-60% function as ICU beds while the remainder provide an HDU service. The beds providing the ICU service are under significant and constant pressure and are failing to meet the clinical demand.

REFERENCES

1. Osborne M and Evans T W. Allocation of resources in intensive care: a transatlantic perspective. *Lancet* 1994; **343**: 778-780.
2. Sibbald W J, Eberhard J A, Inman K J and Sprung C L. New technologies, critical care and economic realities. *Crit Care Med* 1993; **21**: 1777-9.

3. Stoddart J C. National ITU audit 1992/1993. The Royal College of Anaesthetists, 1993.
4. Working Party of the Association of Anaesthetists of Great Britain and Northern Ireland. Intensive Care Services – provision for the future. The Association of Anaesthetists of Great Britain and Ireland, 1988.
5. The Intensive Care Service in the U.K. Intensive Care Society (1990). HMSO.
6. Standards for Intensive Care Units. Intensive Care Society (1990). HMSO.
7. Task Force of European Society of Intensive Care Medicine. Guidelines for the utilization of intensive care units. *Intensive Care Med* 1994; **20**: 163-4.
8. Task Force: Recommendations on minimal requirements for Intensive Care departments. European Society of Intensive Care Medicine (1996).
9. The International Task Force on safety in the Intensive Care Unit. International standards for safety in the intensive care unit. *Crit Care Med* 1993; **21**: 453-6.
10. Clinical Resource and Efficiency Team (CREST). Adult Intensive Care Services in Northern Ireland, 1993 .
11. Working Party of Association of Anaesthetists of Great Britain and Ireland. The High Dependency Unit - acute care in the future (1991).
12. Knaus W A, Draper E A, Wagner D P and Zimmerman J E. APACHE II: severity of disease classification system. *Crit Care Med* 1985; **13**: 818-829.
13. Morrow B C, Lavery G G, Blackwood B M and Fee J P H. Intensive Care and High Dependency Care in a tertiary referral Intensive Care Unit. *Irish J Med Sci* 1994; **163(13)**: 7.
14. Keene A R, Cullen D J. Therapeutic intervention scoring system: update 1983. *Crit Care Med* 1983; **11**: 1-3.
15. Gentleman D and Jennet B. Audit of transfer of unconscious head-injured patients to a neurosurgical unit. *Lancet* 1990; **335**: 330-4.
16. Ridley S and Carter R. The effects of secondary transport on critically ill patients. *Anaesthesia* 1989; **44**: 822-7.
17. Runcie C J, Reeve W R and Wallace P G M. Preparation of the critically ill for inter-hospital transfer. *Anaesthesia* 1992; **47**: 327-331.
18. Lavery G G, Donnelly P B, Dundee J W. Intensive care patients in district hospitals. a case for transfer? *Anaesthesia* 1984; **39**: 596-9.
19. King's Fund Panel. Intensive care in the United Kingdom: report from the King's Fund panel. *Anaesthesia* 1989; **44**: 428-431.